

The Effect of Quadrupole Magnetic Fields on Main Injector BPM Measurements.

1/31/97

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With help from the Magnet Test Facility, a Main Injector style BPM was placed inside an 84 inch Main Ring quadrupole. The magnet current was ramped from a few amps to 4000 amps in several seconds and held at high current for about one minute. To model beam current, a 1/4 inch diameter stainless steel rod was supported inside the BPM and driven at one end with a 53 MHz sine wave. The opposite end was left open to insure no DC current could flow in the rod, figure 1. The BPM outputs were connected through a combiner box to a Main Ring style AM to PM rf module. Thus, the test closely modeled the Main Injector configuration. The BPM to combiner box cables could be arranged to form either a horizontal or vertical detector.

The rf module output is about 146 mV/mm for the horizontal configuration and 106 mV/mm for the vertical, figure 2. The noise level from a typical rf module is about 20 mV rms. With the beam simulation rod placed at the center of the BPM there was no measurable effect of quadrupole current on the rf module position output. However, when the rod was placed 5 mm horizontally and 5mm vertically off axis, a small offset in rf module output was measured, figures 3 and 4. The measured offset was proportional to quadrupole current, and amounted to an equivalent position of .090 mm in both the horizontal and vertical planes at 4000 amps. No dI/dt effect could be seen.

We believe the magnetic field from the quadrupole is exerting a force on our measurement rod and moving it by about 0.005 inches. After performing this experiment, we measured the relative permeability of the 1/4 inch diameter stainless rod to be slightly less than 1.1. We conclude the quadrupole magnetic fields have no measurable effect on the BPM system as designed for the Main Injector.

We would like to thank Jim Garvey and Jim Sim of the Magnet Test Facility for their assistance.




Main Injector BPM Label

NAME

DATE 8/28/96

REVISION

 **Fermilab** Main Injector BPM
9508-MD-337184
S/N 1000
Hor offset H=2.875"
Ver offset V=2.875"
Test Date 8/96
Approved

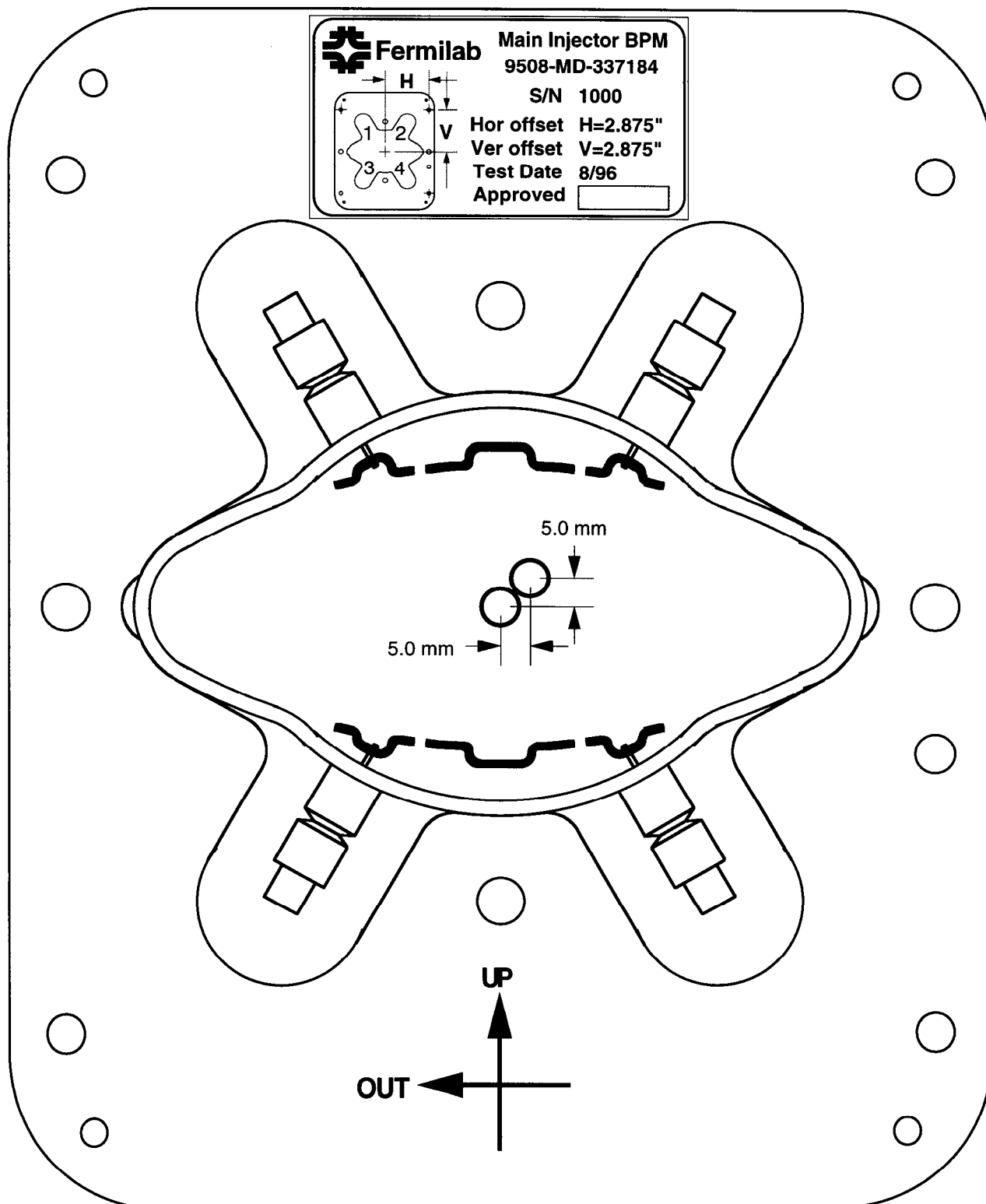
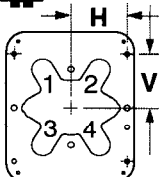


FIGURE 1

1st sqr fit +/-10mm
hor mV/mm 146
ver mV/mm 106

FMI BPM System Axis Position Data

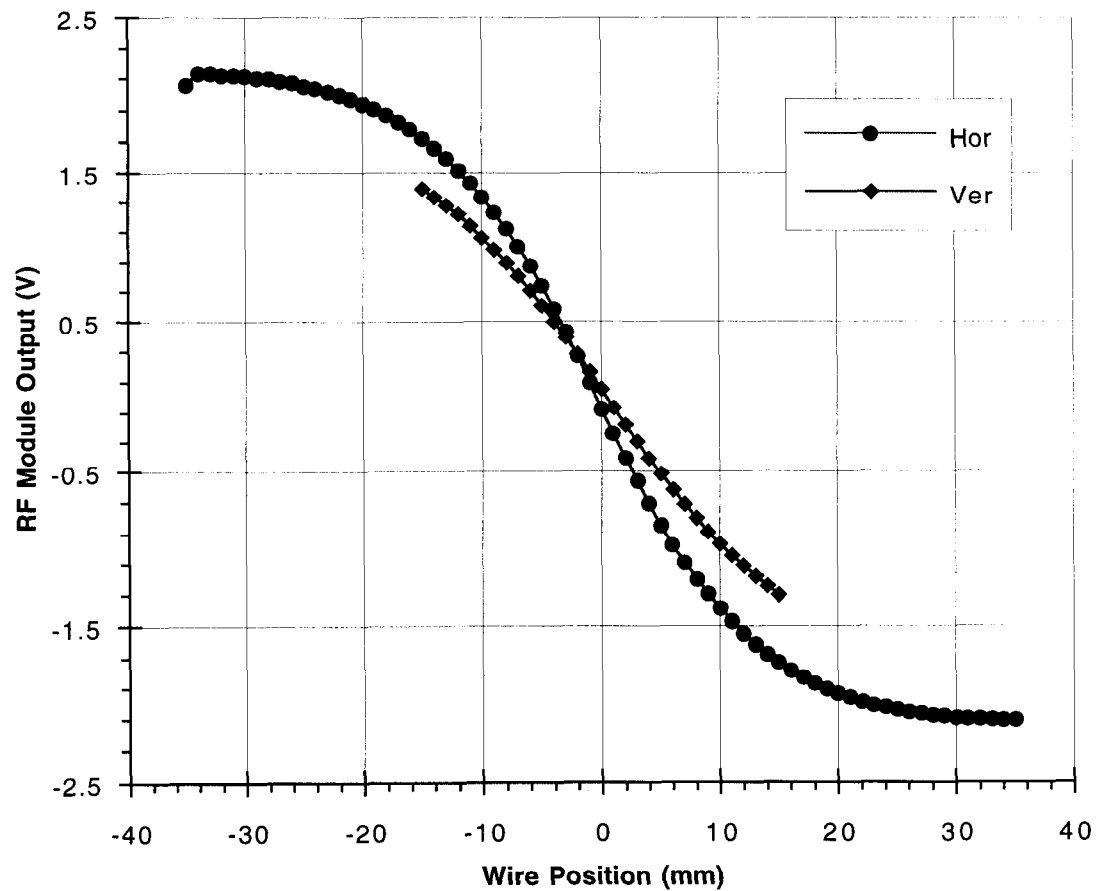


FIGURE 2

84" Quad 0 to 4000 AMPS HOR 146mV/mm

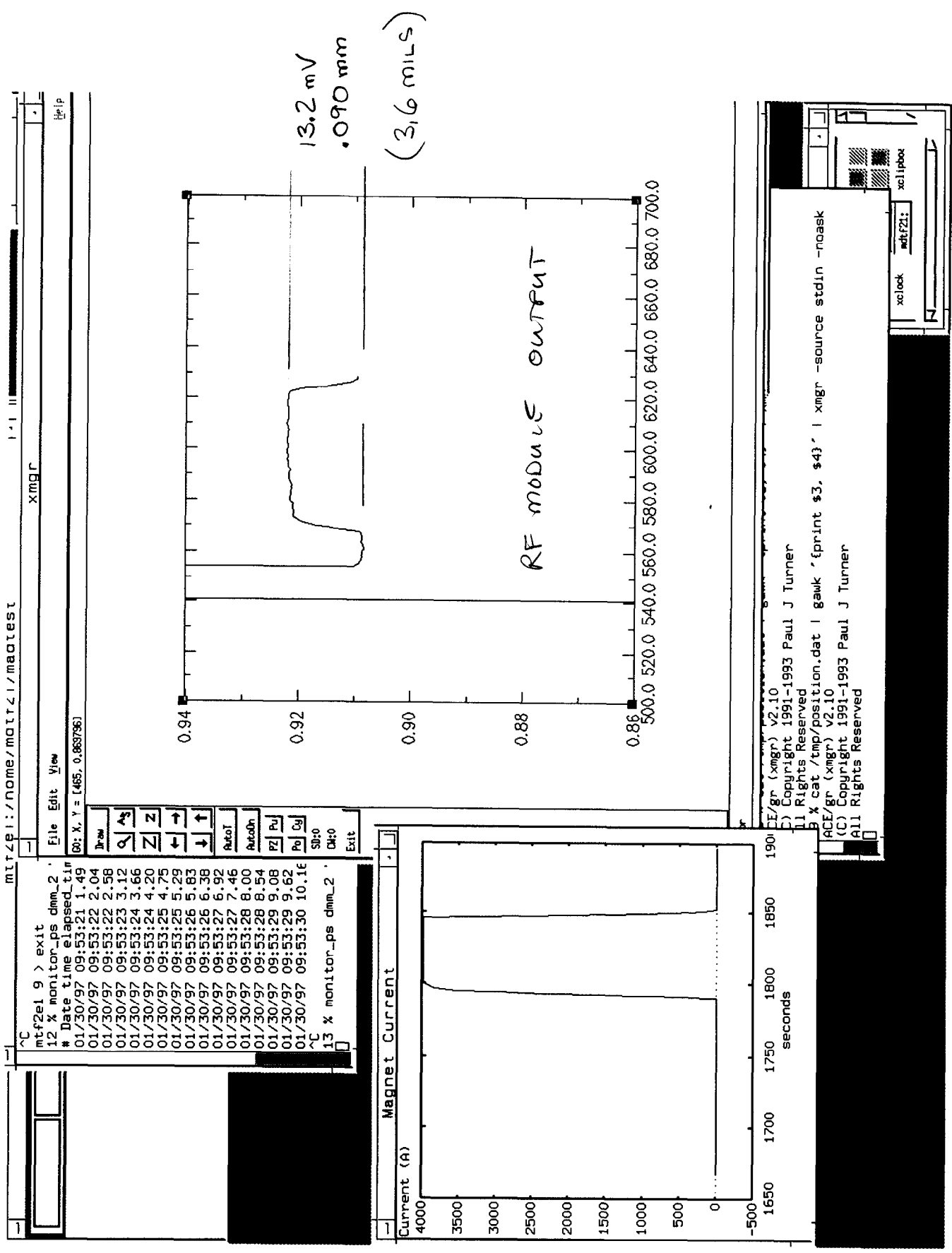


FIGURE 3

84" Quad 0 to 4000 Amps

